ATLANTIC WASTE ECOPARK PAVING PROJECT

Design and Specification Report

Report Number 1379r1v1d1114

Commissioned by
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NOVEMBER 2014

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1 INTRODUCTION

Atlantic Waste Ltd operates a waste transfer station on land at Newton Farm, Rhymney, Cardiff. Its associated company Neal Soil Suppliers operates a waste soil processing facility on adjacent land. Both activities require significant areas of land to be provided with infrastructure which reduces the risk of pollution to the protected watercourses that run through the sites. Environmental Permits require that areas used for storing non-hazardous and hazardous waste should be provided with an impermeable surface with a sealed drainage system. Currently, only a small proportion of both sites meet the requirements and large areas remain in need of paving.

To date, all paving at both sites has been constructed using a conventional reinforced concrete slab cast over an unbound sub-base layer and capping layer. The concrete provides a robust surface as well as a structural paving, resisting cracking by the provision of reinforcement. The concrete has been batched off-site using only primary aggregates in its formulation and is supplied to meet the client's specification. Independent Construction Quality Assurance provides a high degree of confidence in the infrastructure. Continuation of this paving system is envisaged where there is a need to extend existing paved areas with this design, though until now the various other options for providing an impermeable surface with sealed drainage have not been explored.

Geotechnology Ltd has been commissioned to examine the paving options available to achieve the desired surfacing. A number of systems are commonly used to provide heavy duty paving and the design of these systems is covered by published guidance which has been referred to in drafting this document. The formulation of the mixes is also the subject of guidance which points to the latest aggregate standards. Where it is permitted to use materials manufactured from waste the regulatory position has also been considered.

The objective of this document is to identify various acceptable means of achieving the required impermeable surfacing so that the operator is not constrained to using just one design, which has been the case until now. The formulation of each component of the various systems is considered in this document and will have to comply with the relevant standards. The outcome of adopting this document should be a more flexible approach to surfacing. It offers assurance for all parties that the paving will meet the objectives required in the permit and will not contravene any regulatory requirements for any component used in the paving.

2 THE SITE AND PRELIMINARY PHASING PLAN

This proposal considers the immediate paving requirements at the Atlantic Waste site. Figure 2 shows those parts of the site considered priorities for paving. These are:

- Transfer Station Yard Extension (Stockpile 1) 3545m^2
- Field 1 (RDF Storage) 38750m^2

The yard extension is likely to follow the previously used Reinforced Concrete design, but Field 1 is stand-alone area and therefore any acceptable option could be considered for this. Figure 2 shows that Field 1 is to be split into a number of Stages with RDF storage following closely behind the placement of infrastructure.

In order to fully understand any design constraint arising from ground conditions a programme of in-situ testing has been undertaken. A total of 12 in-situ California Bearing Ratio tests have been carried out throughout the areas identified as paving priorities. The in-situ CBR values ranges from only 0.8% on the wet natural clay soils to 20% on the surface of an existing unbound road. It is clear that the design will have to accommodate a wide range of support conditions and this issue can only be addressed by a programme of testing prior to each paving phase or an undesirable conservative design to be applied in all areas.

Managing the variability of the ground conditions is likely to prove difficult in practice due to the inherent localised variability and therefore the designs have been specified to accommodate all ground conditions other than CBR values of less than 5%, which will require bespoke consideration.

Given the size of the area to be paved it is not practical to expect completion in a single phase. The paving will be carried out in a series of panels which gradually merge across the whole area to provide a continuous unbroken impermeable surface, with integral drainage details at the edges of the paving. Several issues arise as a result of this statement: each discrete area will need ground conditions checked; if a panel terminates short of the edge drain a temporary provision is needed; construction joints will be needed and slab levels need to be carefully controlled to ensure accurate falls are maintained.

3 THE DESIGN OF HEAVY DUTY PAVING

Paving large areas for industrial purposes is not uncommon and there are numerous sources of reference for ways in which the paving can be designed and constructed. Many of the design approaches are an evolution of detailed Department for Transport (DoT) guidance on the design of road infrastructure, though modification is required as the industrial paved areas are subjected to smaller numbers of passes of heavier axle loads than roads. The available design approaches point toward currently widely used documents produced by DoT and also to current British and European Standards. As a niche area, design guidance is produced by interest groups formed by the companies that provide services and materials to industrial paving. Key design guides for this project include the BritPave document "The Design and Specification of Heavy Duty Paving", the British Ports Association document "Port and Heavy Duty Pavement Design Manual" and the BritPave document "Guide to Roller Compacted Concrete". All documents are appended to this report for ease of reference.

The design basis for heavy duty paving is the avoidance of excessive deflection in the pavement when traversed by heavy plant. The deflection is a consequence of point loading the surface and the response of the ground and the pavement structure to the load. The ground support conditions are an important element in this consideration and to avoid excessive deflection in the paving over weak ground the paving has to be strengthened or the ground improved to limit deflection. This can be achieved by thick high strength reinforced concrete over a suitable unbound sub-base and capping layer or by the use of a thinner concrete surfacing over a thickened layer of bound sub-base over an unbound capping layer. Both design options have merit and will achieve the desired impermeable pavement and therefore a single plan that allows both systems to be used seems appropriate.

Schedule A6 of Table S1.1 of the Environmental Permit requires that the outside areas used for the storage of non-hazardous wastes are covered with an impermeable surface. The Permit does not define "impermeable" but it is generally accepted to mean an unbroken robust surface normally comprising concrete but on occasion possibly asphaltic surfacing. The key aspect of the definition is that the surfacing must be "impermeable" to water; therefore whichever surface is selected it must be resistant to cracking through the full thickness of the surfacing. Both concrete and asphaltic surfacing has to be placed onto a resistant layer provided specifically to support the overlying surfacing material.

Concrete is a rigid brittle material that has very limited capability to accept deformation. For this reason it is normally placed in a series of discrete panels with flexible joints between and is normally reinforced with steel mats placed onto the support layer or steel fibres dispersed within the mix. The support layer is designed to provide a high degree of uniform support and has to be designed to accommodate the anticipated loadings that will be applied during its service life. The support layer is in fact the key element in achieving a rigid pavement with the surface course providing a high strength resistant wearing surface. Asphaltic surfacing is constructed with the same design philosophy but is far less common in heavy duty applications as the surfacing is less robust. Asphaltic surfaces can accommodate lower strength support layers as it is able to tolerate a certain degree of movement though this flexibility is gained at the expense of robustness. It is therefore uncommon to find asphaltic surfacing in high load, high wear situations such as waste transfer activities.

The Manual of Contract Documents for Highway Works, Volume 7, Section 2, Part 3 (HD 26/06) provides a rational method for the design of paving for new trunk roads. Whilst this document is of relevance to the provision of paving in general, it is tailored specifically for trunk road use and its design philosophy has to be extended to provide functional designs for industrial paving. As the document does not provide an easily used design guide for industrial paving, Britpave (the British In-situ Concrete Paving Association) has published Technical Guideline 3 "The Design and Specification of Heavy-Duty Paving".

Heavy-Duty Paving is defined as paving for axle loads in excess of those permitted on public roads. It includes heavy industrial yards where large plant operates: such circumstances are clearly beyond the scope of the highways design guidance. The guidelines are applicable to:

- The use of hydraulically bound mixtures (HBM) mixed in central plants where the aggregate may comprise natural, artificial or recycled material
- In-situ stabilised mixtures, also referred to here as HBM, produced by stabilising granular materials that occur naturally within the ground at paving level or granular materials that have been placed in advance of paving works
- Binders or hydraulic combinations based on Portland cement, quicklime or hydrated lime, ground granulated blast furnace slag and coal fly ash

The strength characterisation and specification for HBM is in accordance with the European Standard for HBM introduced as British Standard BS EN 14227:2004 and BS EN 14227:2006 Parts 1-5 and 10-14 as well as the MCDHW, Volume 1: Specification for Highway Works, Series 800: Road Pavements- Unbound, Cement and other Hydraulically Bound Mixtures.

It is not absolutely necessary to use HBM in the paving make-up as acceptable results can be achieved with reinforced concrete paving over unbound aggregate layers. Such a build-up requires significant thicknesses of unbound, compacted aggregates, comprising a capping layer overlain by Subbase and Roadbase before being overtopped with a thick (normally 300mm) reinforced concrete slab. The reinforcement details are designed to accommodate the deflection expected over an unbound build-up and can result in significant reinforcement.

At this site there is a requirement for a significant area of impermeable surfacing to be provided and this area includes areas already covered with aggregates and subjected to plant loads, areas around existing fixed plant and yards and areas with natural ground surfaces exposed. Together with existing ground level variation and proposed surfacing fall requirements it is fair to say that the conditions across the site are highly variable. Accordingly, Atlantic waste wishes to agree not a single design for the entire site, but a series of acceptable slab designs from which the most appropriate for the particular location can be selected and used without the need for further consultation. Accordingly, this document provides three basic designs and then considers the range of acceptable materials that could be used in each of the designs to ensure a finished product that is fit for purpose, robust and fully compliant with established Standards and guidance.

4 DESIGN OPTIONS

4.1 Surfacing

4.1.1 Reinforced Concrete

The paving may be constructed using conventional reinforced concrete. If placed over an unbound sub-base the slab will be a minimum of 250mm thick with reinforcement. When placed over a bound sub-base the reinforced concrete may be reduced in thickness to a minimum of 125mm.

4.1.2 Roller Compacted Concrete

The surfacing of the paving needs to be sufficiently robust to allow heavy plant to operate and potentially for front loading shovels to collect material from the floor. The use of HBM/CBM in such applications is not good as the low strength matrix allows strong aggregate particles to be "plucked" from the mass, resulting is high wear and corresponding high maintenance. A wear resistant surface is required; though it need not provide great structural strength (for example many container terminal pavements are surfaced with 80mm concrete paver blocks laid loose but interlocking). At this site the wearing surface may comprise the top of the high strength reinforced concrete layer but in areas where bound aggregate support layers are used the wearing surface may be a 150 - 200mm thick mass concrete overlayment. The concrete can be laid effectively over large areas using the roller compaction method, a system developed for and used almost exclusively for extensive areas of flooring or paving.

Roller compacted concrete is an engineered mixture of graded aggregates, cement and water, batched on site or off site at low moisture contents. The mix is stiff yet it is easily compacted using conventional earthworks rollers to form a dense, durable surfacing ideally suited to areas of plant movement and front loading shovel operations. RCC requires no construction joints, reinforcement or dowelling so is quick and economical to use and it is commonly used to pave areas for the waste industry.

4.2 Support Layers

4.2.1 Unbound Sub-Base

Unbound aggregates are conventionally used in support layers and their use must be in compliance with Series 800 of the Specification for Highway Works

4.2.2 Bound Sub-base

Hydraulic Bound Material (HBM) and Cement Bound Material (CBM) is stiffer than unbound aggregates and therefore can form an important part of the paving system in heavy use applications. Both materials are produced by blending the aggregate material with a stabiliser/binder to produce a setting material which is conventionally used beneath a surfacing layer. The HBM/CBM layer provides the strength in the system whilst a thin overlayment of asphalt, concrete or pavers provides a durable wearing course. HMB/CBM can be made in two ways, both of which are recognised in the standards and guidance. The ex-situ mixing method utilises a batching plant to mix measured batches of aggregate and binder, providing a material with very consistent mix proportions, allowing the absolute minimum binder content to be used to achieve the required strength.

The in-situ method mixes a binder into a layer of aggregate already placed into its final position. Measured doses of binder are spread onto the surface and a rotivating plough mixes the components together to the depth of the rotivator. This method produces a well-mixed material but to overcome the possibility of less than perfect mixing the layer is slightly overdosed with binder. This method is suitable for a single lift of material to a maximum thickness of 310mm. Where the total thickness of HBM/CBM requires a second lift then the second lift has to be mixed ex-situ as the rotivator must not strike and mix any of the set lower layer.

4.2.2 Unbound Capping Layer

Where the in-situ CBR is less than 7% (1,4 and 5) an unbound capping layer is required prior to the placement of the Base/Sub base layers and the lack of good support also indicates that these too need to be thickened. Conversely, where the CBR exceeds 15% the ground is providing good support and the paving can be placed onto thinner support layers.

4.3 Fill to Formation

The site area is very flat as it lies within the Wentloog Levels and therefore the development of large areas of paving is problematic as the site contains little natural fall. Accordingly, gradients have to be established by either cutting into the ground, filling above the ground or a combination of both. The largest area to be covered is Field 1 which measures 165m by 240m. If a gradient of 1:100 is to be maintained then the cross fall required will be 1.65m (ie one end of the paving needs to be 1.65m higher than the other side). The need for such a large build up can be avoided by splitting the area to incorporate falls that radiate outward. In this case the cross fall from centre to edge will be reduced to 1.2m.

The outer edge of the paved areas will be detailed with a surface water collection drain as shown on Figure 4. As this drain must fall under gravity to the water collection ditches around the site it is not possible to reduce the level of the slab edges below existing water levels around the site. These water levels are some 200mm below existing ground level so the paving edge drains must be set at or very close to existing ground level. Accordingly, the ground beneath the paving will have to be built up with varying amounts of imported fill to achieve the required levels for the underside of the capping layer.

4.4 Design Combinations

Figure 3 shows that a number of design combinations are possible. Ground levels may need to be amended to produce the require falls in which case there is an opportunity to use selected materials to provide improved ground support conditions. A layer of fill complying with Series 600 of the Specification for Highway Works should be used to build up ground levels.

Ground support may be very poor, very good or anywhere between. Where support conditions are poor a capping layer will be required. The capping function will always be provided with an unbound aggregate.

Sub-base may be unbound or bound. The overlying surfacing layer shall be either reinforced concrete (for both unbound and bound sub-base) or roller compacted concrete (over bound sub-base only). Where durability of surface is not an issue unsurfaced CBM may be used but the strength of the CBM must be sufficient to provide the required pavement performance.

5 PERMISSABLE MATERIALS

Materials that may be used in the formulation of paving include natural (primary) aggregates, recovered (secondary) aggregates and recycled aggregates. Aggregates produced from inert waste shall comply with the WRAP Protocol.

Aggregates recovered from Incinerator Bottom Ash (IBA) and Steel Slag are currently the subject of an Environment Agency Position Statement (017) which is adopted by NRW. Quality protocols for deriving aggregates from such wastes are not yet agreed, hence the RPS. Until such time as an approved quality protocol supercedes the RPS all aggregates used in the scheme that are produced from IBA or Steel Slag will comply with terms of the RPS. It is noted that aggregates derived from these sources are appropriate for the end uses proposed in this document:

5.1 IBA Aggregate

RPS 017 indicates that IBA Aggregate should be processed for final use in:

- Unbound applications, such as fill beneath ground bearing slabs, sub-base and capping layers
- Bound Highway applications, such as construction and maintenance of roads, sub-base and capping layer
- Construction applications such as cement bound material or concrete

Accordingly, the proposed use is in accordance with the regulatory position statement. The RPS also points to the standards identified above and in order for the material to be acceptable all the conditions of the RPS must be met. The IBA aggregate will cease to be waste once placed to its final use and will remain waste until completely recovered in its final use.

5.2 Steel Slag Aggregate

RPS 017 indicates that Steel Slag Aggregate should be processed for final use in:

- Civil engineering road applications including unbound applications, such as sub-base and base layers, chippings and replacement aggregate
- Civil engineering road applications including hydraulically bound applications, such as sub-base and base layer
- Civil engineering non-road applications including structural fill and backfill

Accordingly, the proposed use is in accordance with the regulatory position statement. The RPS also points to the standards identified above and in order for the material to be acceptable all the conditions of the RPS must be met. The steel slag aggregate will cease to be waste once placed to its final use and will remain waste until completely recovered in its final use.

6 JOINT AND EDGE DETAILS

Drainage is to be provided by an edge drain cast into the edge of the slab as shown on Figure 4. This has the capacity to remove runoff from even the largest of slabs before dropping the water into holding lagoons prior to pumped discharge. However, though the sequencing will be careful to develop paving up-gradient from low points there will always be lateral edges that are not closed and therefore a temporary solution is required to contain runoff until the paving is extended when the temporary solution has to be removed.

A temporary works solution is under development in collaboration with Colas Ltd, a specialist road surface sealant manufacturer and comprises a series of 2m long concrete beams of 150mm by 200mm section fixed to the slab with semi-flexible bituminous mastic. This provides a complete seal, yet when adjacent paving is available it can be removed with a mechanical knife fixed to an excavator. The beams are then available for the next temporary edge. New panels will not come into use until the edge is provided with a functional containment system.

Construction joints are to be provided at edges and these will be stepped to ensure that joints in the capping and sub-base/base do not directly underlie joints in the slab above. Where reinforced concrete is used the joints will be conventional expansion joints filled with compressible filler before being overtopped with flexible sand filled bitumen mastic.

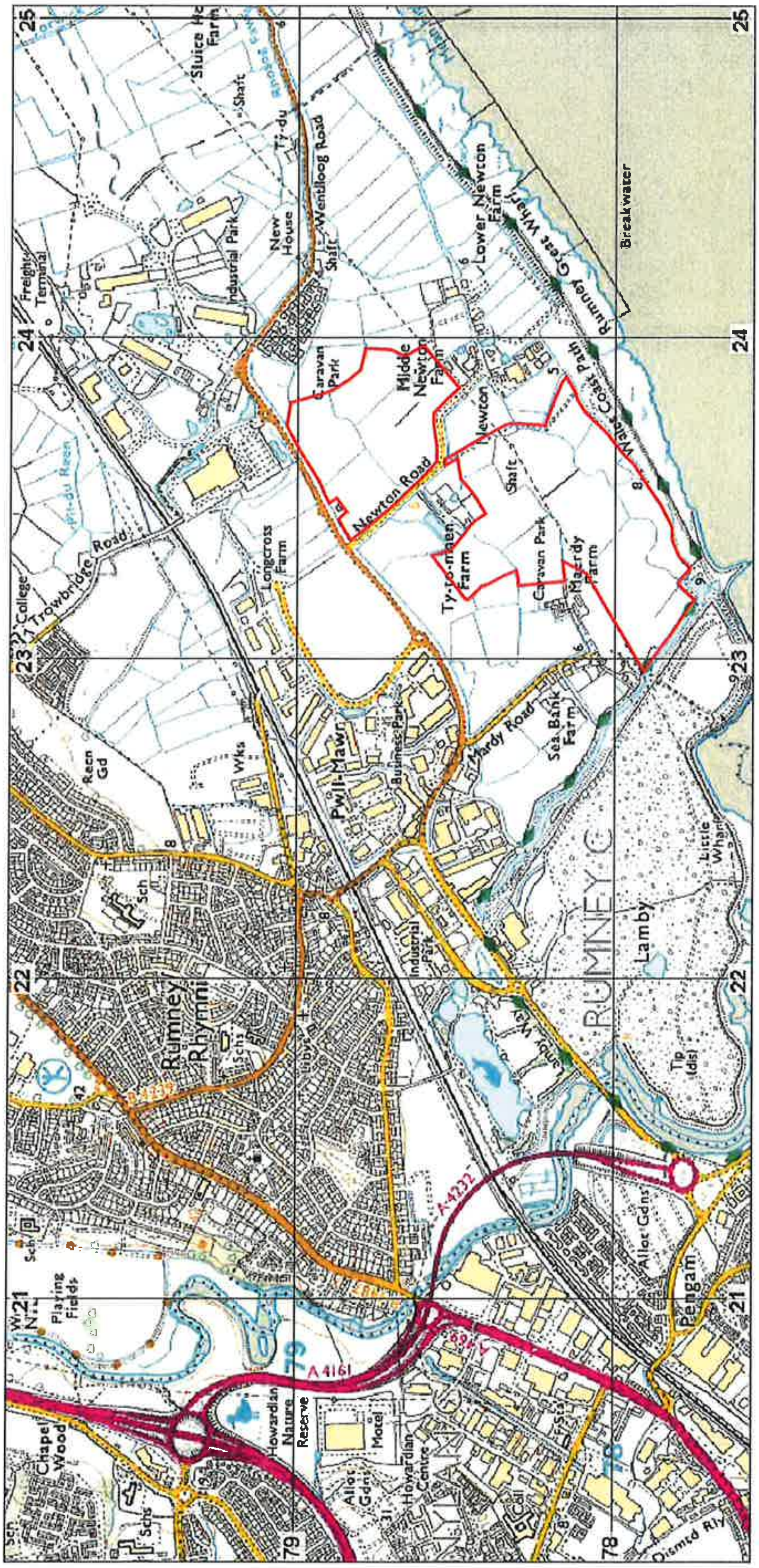
Anti-crack joints will be used across the entire paved area. Where reinforced concrete is used these will be formed by shuttering or cutting but where Roller Compacted Concrete is used these will be formed by cutting. Cut contraction joints will be made in accordance with Figure 7/1 of the Manual of Contract Documents for Highway Works, Volume 1, Series 700.

7 CONSTRUCTION QUALITY ASSURANCE

The Permit does not require the submission of Construction Quality Assurance Plans and Verification reports for the development of site infrastructure; nevertheless Atlantic proposes to follow a system of pre-works agreements followed by post works verification. Verification of the construction and suitability of the works will be carried out by an independent supervising organisation using validation records maintained during the construction works.

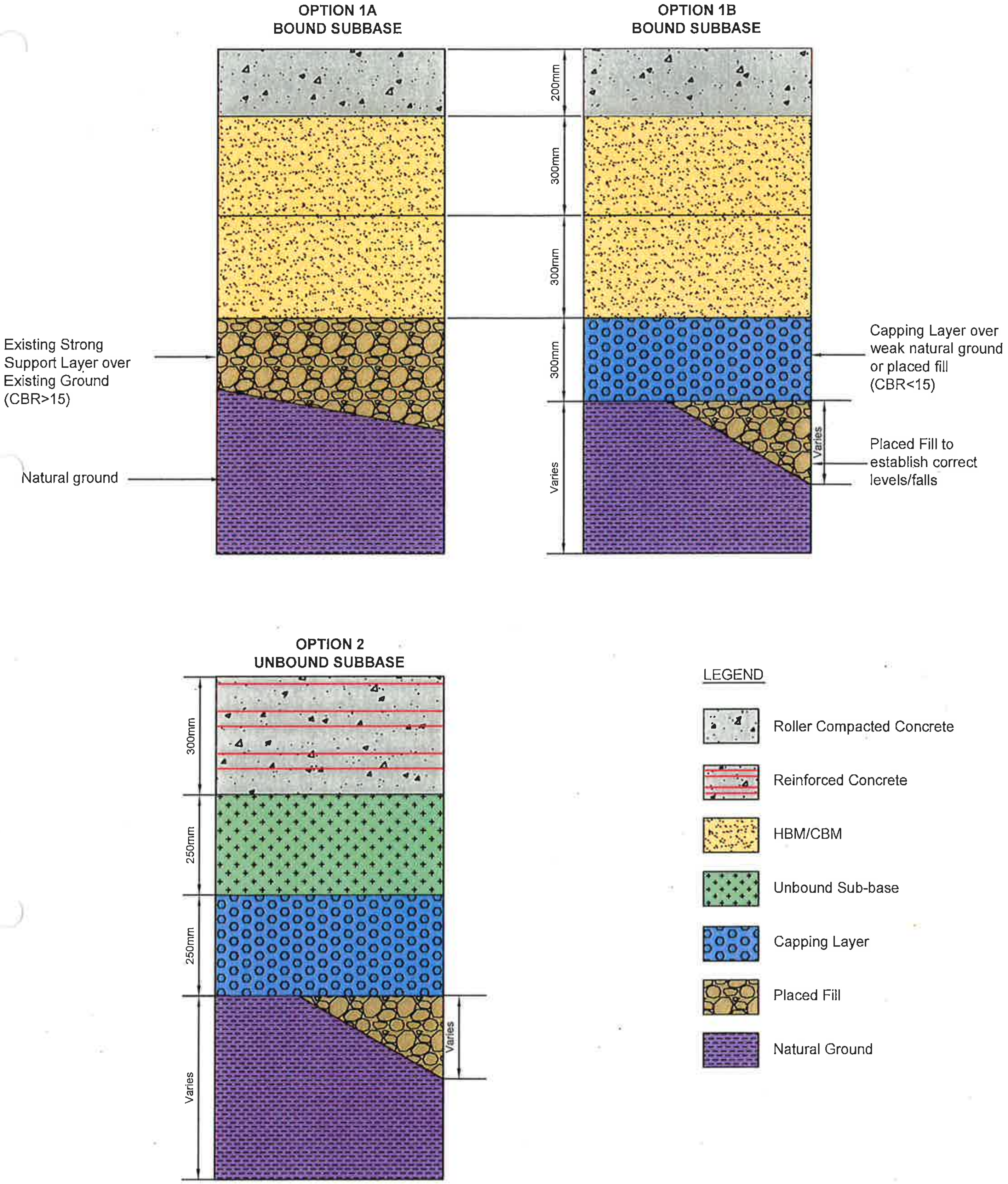
The CQA process will begin with the submission of this general report outlining suitable systems, construction methods, materials and formulations so that the company has available a range of acceptable paving options which may be used throughout the site. Prior to commencement of a particular Stage a plan will be provided to NRW outlining the extent of the proposed works, the duration of the works and the method of construction. A summary of the validation data that will be maintained throughout the construction will also be provided.

Upon acceptance of the proposals by NRW construction will be carried out as described under the supervision of an independent third party. The CQA consultants will collate the construction records, photographs and as-built drawings and will provide these upon completion to NRW together with a statement that the infrastructure is fit for purpose.



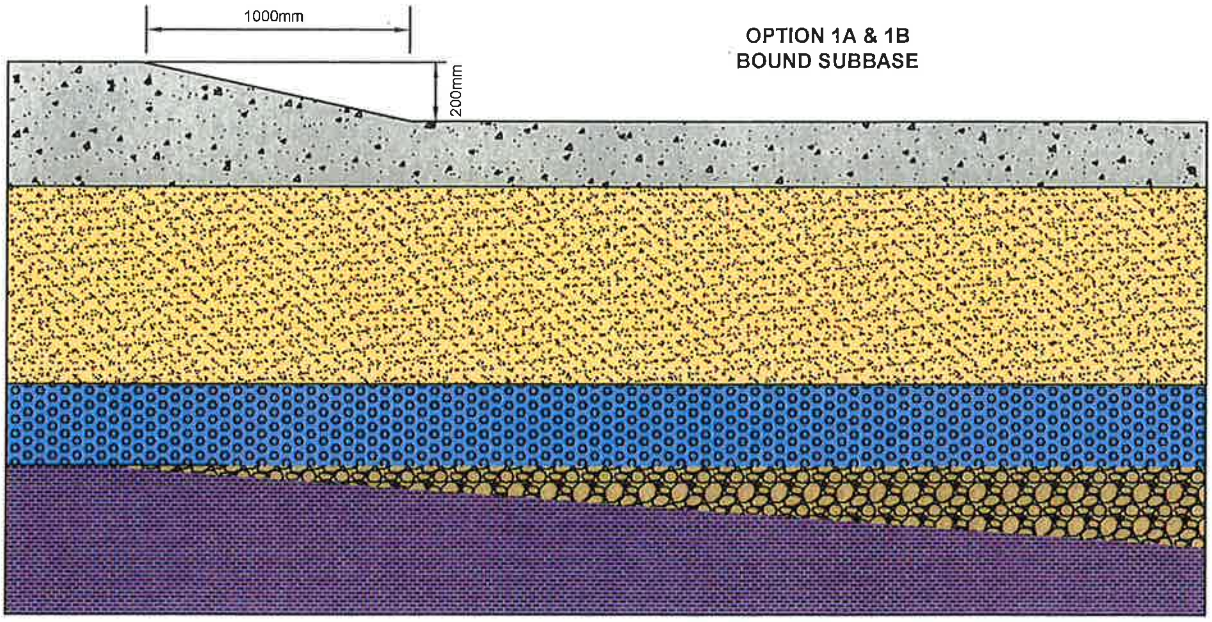
PROJECT **Atlantic Waste EcoPark Paving Project**	DRAWING NUMBER **1379 Figure 1**		
	SCALE AT A4 **as shown**	DATE **11.14**	DRAWN **ET**
TITLE **Site Location Plan**	NOTE		

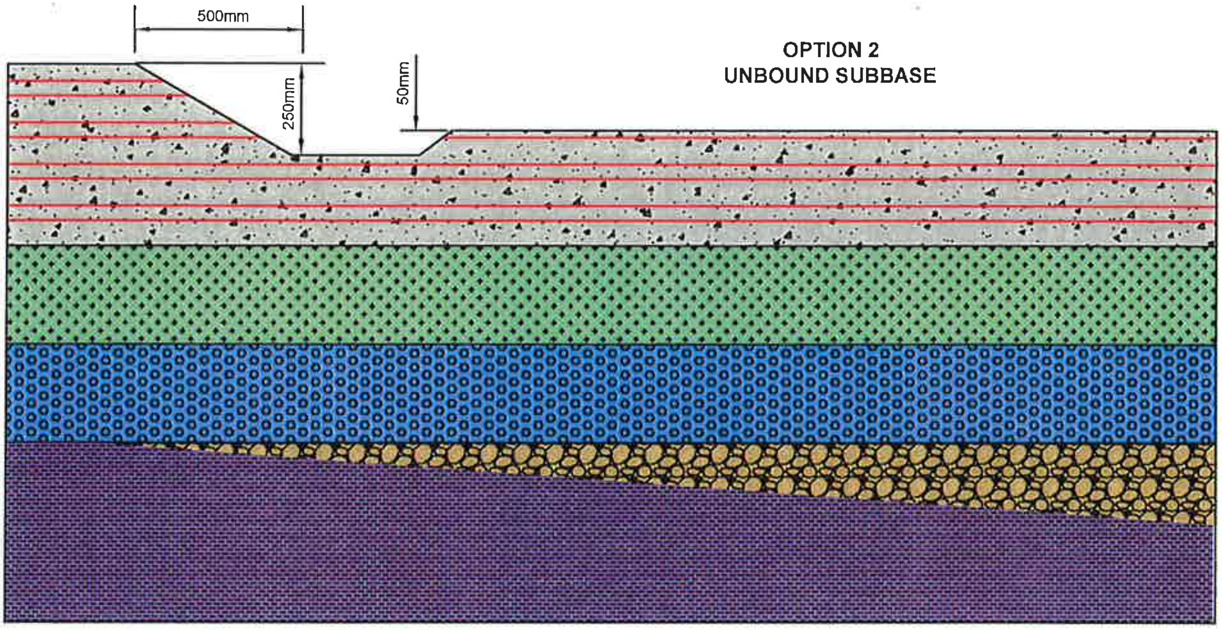
GEO TECHNOLOGY



PROJECT	DRAWING NUMBER		
Atlantic Waste EcoPark Paving Project	**1379 Figure 3**		
	SCALE AT A4: **NTS**	DATE: **11.14**	DRAWN: **ET**
TITLE: **Paving Construction Details**	NOTE		

GeO TECHNOLOGY





LEGEND

- Roller Compacted Concrete
- Reinforced Concrete
- HBM/CBM
- Unbound Sub-base
- Capping Layer
- Placed Fill
- Natural Ground

PROJECT	DRAWING NUMBER		
Atlantic Waste EcoPark Paving Project	**1379 Figure 4**		
	SCALE AT A4: **NTS**	DATE: **11.14**	DRAWN: **ET**
TITLE: **Paving Edge Details**	NOTE		

GEO TECHNOLOGY

ATLANTIC WASTE ECOPARK PAVING PROJECT

Design and Specification Report

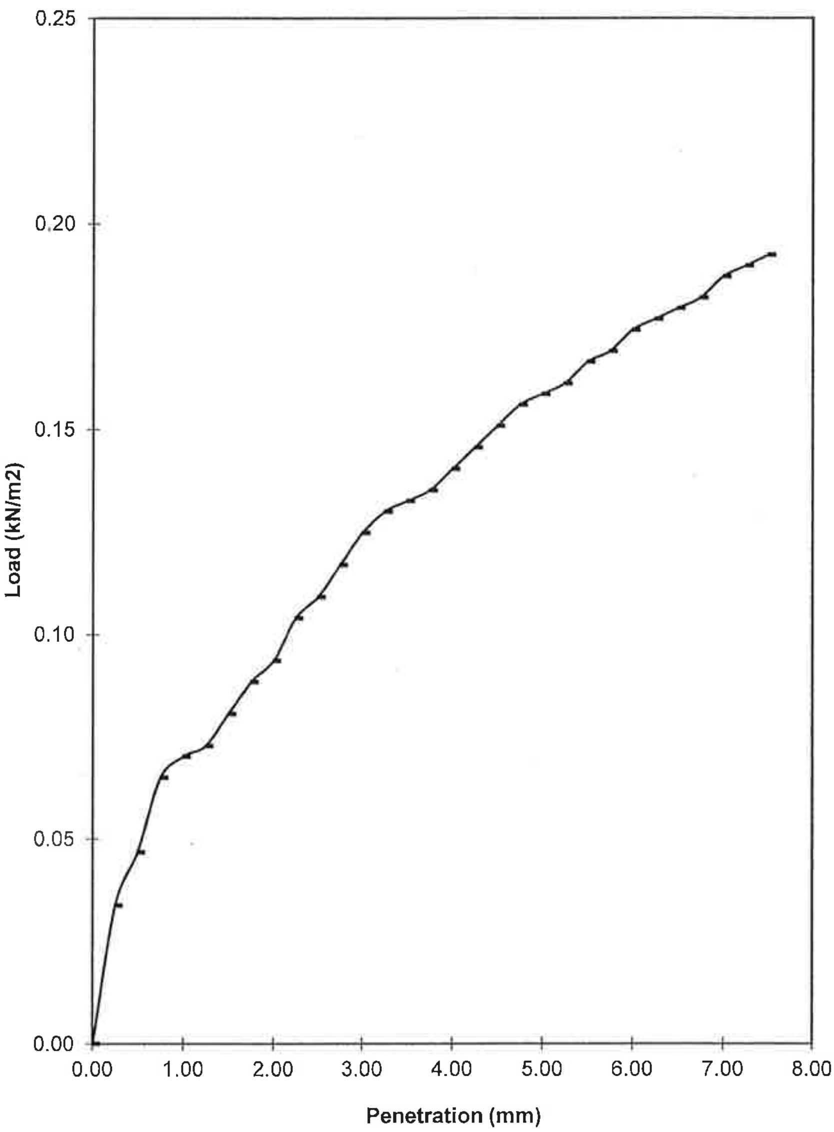
Appendix 1
CBR Testing Results

Report Number 1379r1v1d1114

SOUTHERN GROUND TESTING

IN SITU CBR TEST

PENETRATION (mm)	PR READING (divs)	LOAD (KN)
0.00	0	0.00
0.25	13	0.03
0.50	18	0.05
0.75	25	0.07
1.00	27	0.07
1.25	28	0.07
1.50	31	0.08
1.75	34	0.09
2.00	36	0.09
2.25	40	0.10
2.50	42	0.11
2.75	45	0.12
3.00	48	0.12
3.25	50	0.13
3.50	51	0.13
3.75	52	0.14
4.00	54	0.14
4.25	56	0.15
4.50	58	0.15
4.75	60	0.16
5.00	61	0.16
5.25	62	0.16
5.50	64	0.17
5.75	65	0.17
6.00	67	0.17
6.25	68	0.18
6.50	69	0.18
6.75	70	0.18
7.00	72	0.19
7.25	73	0.19
7.50	74	0.19



Test Depth: 0.40m.	Soil Description: Soft grey CLAY	CBR at 2.50mm 0.82 %
Mass of Split Rings: 5kg		CBR at 5.00mm 0.79 %
PR Factor: 2.6 N/Div		**CBR Value: 0.8 %**
		Checked By: D.M.

REMARKS:

Carried out in accordance with BS1377: Part 9: 1990, Test 4.3

CONTRACT: Atlantic Waste, Wentloog

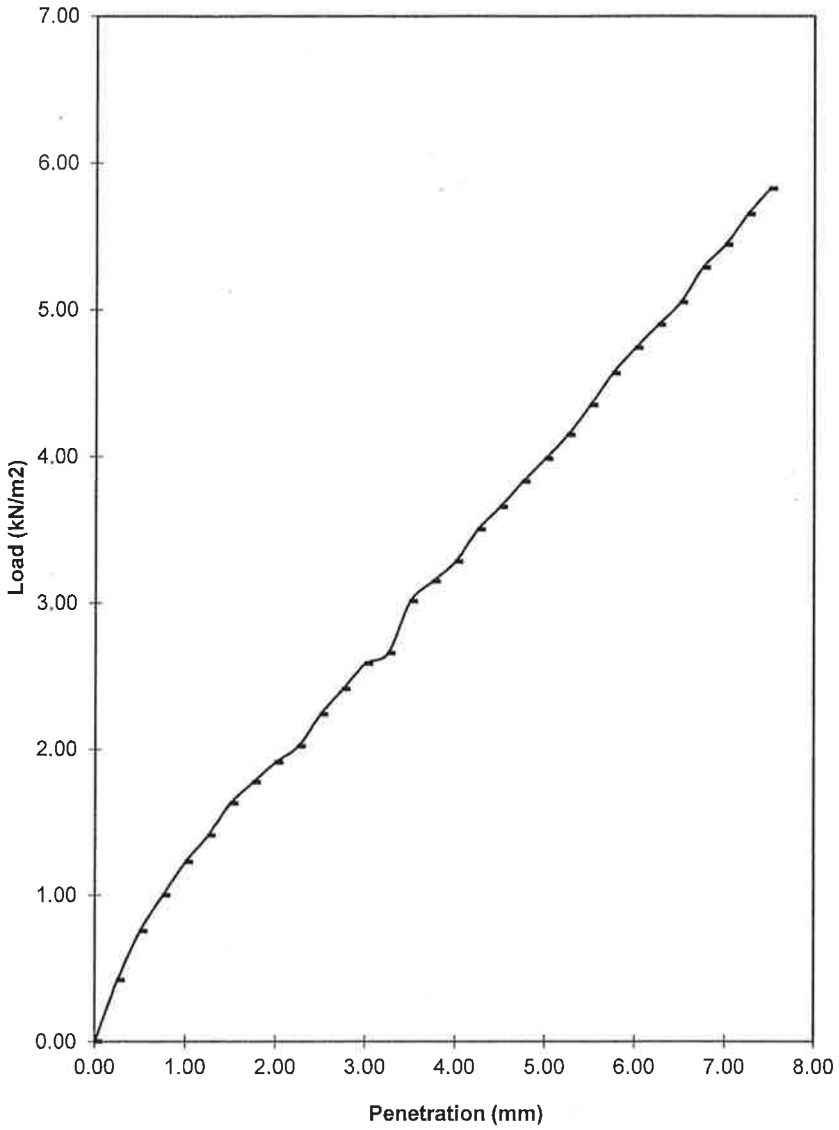
DATE: 27.08.14

TEST REFERENCE: CBR 1

SOUTHERN GROUND TESTING

IN SITU CBR TEST

PENETRATION (mm)	PR READING (divs)	LOAD (KN)
0.00	0	0.00
0.25	46	0.42
0.50	83	0.76
0.75	110	1.00
1.00	135	1.23
1.25	155	1.41
1.50	179	1.63
1.75	195	1.77
2.00	210	1.91
2.25	222	2.02
2.50	246	2.24
2.75	265	2.41
3.00	284	2.58
3.25	292	2.66
3.50	331	3.01
3.75	346	3.15
4.00	361	3.29
4.25	385	3.50
4.50	402	3.66
4.75	421	3.83
5.00	438	3.99
5.25	456	4.15
5.50	478	4.35
5.75	502	4.57
6.00	521	4.74
6.25	538	4.90
6.50	555	5.05
6.75	581	5.29
7.00	598	5.44
7.25	621	5.65
7.50	640	5.82



Test Depth: GL	Soil Description: MADEGROUND: Compact demolition rubble	CBR at 2.50mm 16.91 %
Mass of Split Rings: 0		CBR at 5.00mm 19.97 %
PR Factor: 9.1 N/Div		**CBR Value: 20.0 %**
		Checked By: D.M.

REMARKS:

Carried out in accordance with BS1377: Part 9: 1990, Test 4.3

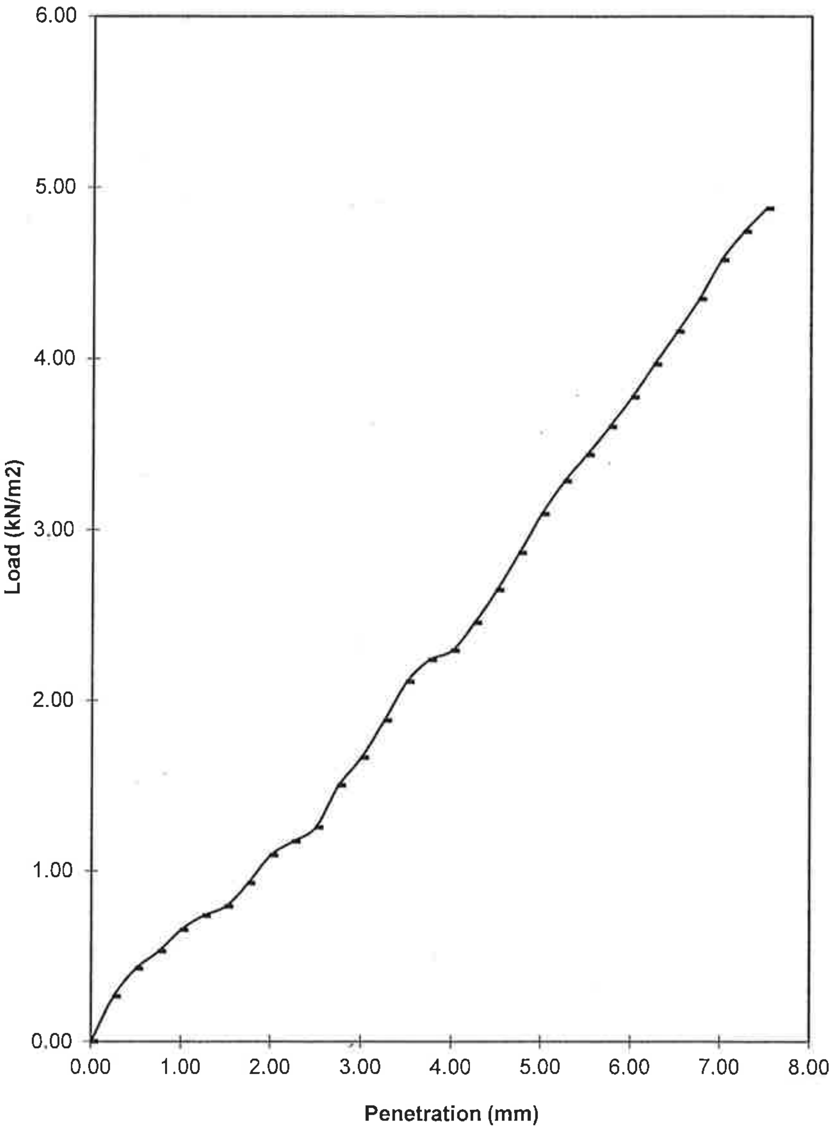
CONTRACT:
Atlantic Waste, Wentloog

DATE: 27.08.14
TEST REFERENCE: CBR 2

SOUTHERN GROUND TESTING

IN SITU CBR TEST

PENETRATION (mm)	PR READING (divs)	LOAD (KN)
0.00	0	0.00
0.25	29	0.26
0.50	47	0.43
0.75	58	0.53
1.00	72	0.66
1.25	81	0.74
1.50	87	0.79
1.75	102	0.93
2.00	120	1.09
2.25	129	1.17
2.50	138	1.26
2.75	165	1.50
3.00	183	1.67
3.25	207	1.88
3.50	232	2.11
3.75	246	2.24
4.00	252	2.29
4.25	270	2.46
4.50	291	2.65
4.75	315	2.87
5.00	340	3.09
5.25	361	3.29
5.50	378	3.44
5.75	396	3.60
6.00	415	3.78
6.25	436	3.97
6.50	457	4.16
6.75	478	4.35
7.00	503	4.58
7.25	521	4.74
7.50	536	4.88



Test Depth: GL	Soil Description: MADEGROUND: Compact brown slightly clayey gravel	CBR at 2.50mm 9.48 %
Mass of Split Rings: 0		CBR at 5.00mm 15.50 %
PR Factor: 9.1 N/Div		**CBR Value: 15.5 %**
		Checked By: D.M.

REMARKS:

Carried out in accordance with BS1377: Part 9: 1990, Test 4.3

CONTRACT: Atlantic Waste, Wentloog

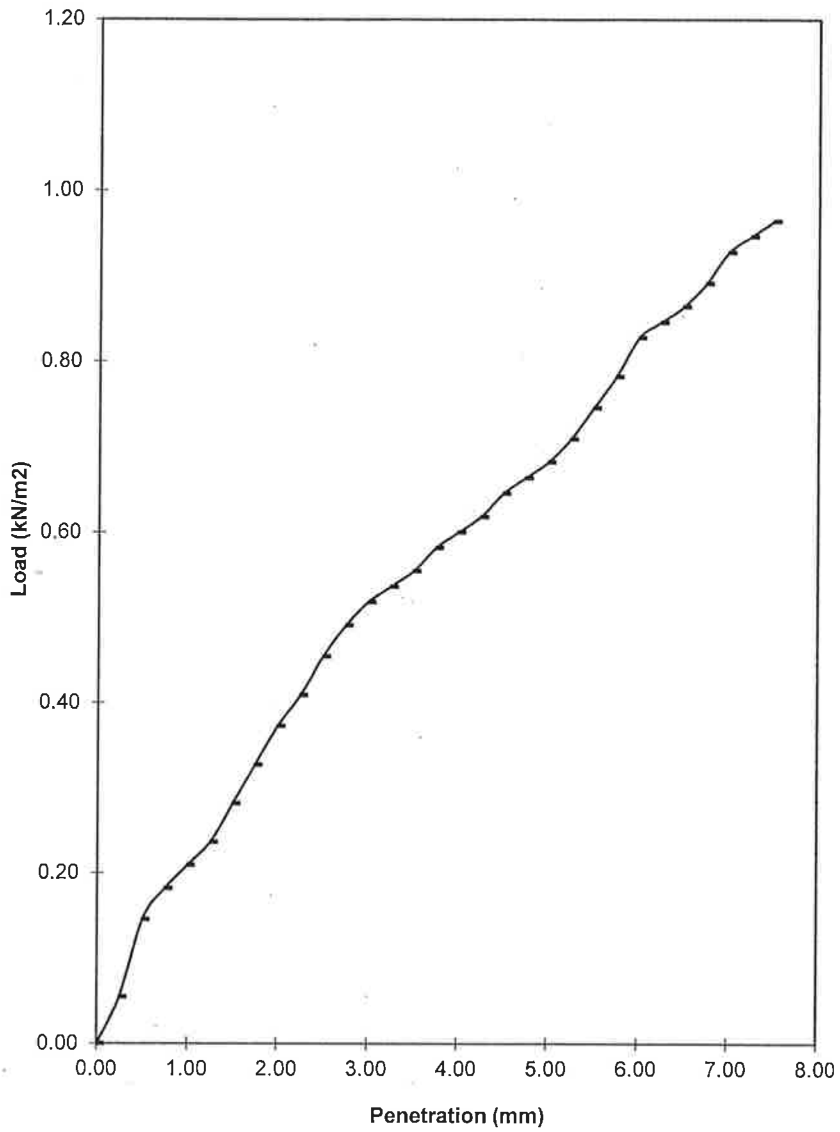
DATE: 27.08.14

TEST REFERENCE: CBR 3

SOUTHERN GROUND TESTING

IN SITU CBR TEST

PENETRATION (mm)	PR READING (divs)	LOAD (KN)
0.00	0	0.00
0.25	6	0.05
0.50	16	0.15
0.75	20	0.18
1.00	23	0.21
1.25	26	0.24
1.50	31	0.28
1.75	36	0.33
2.00	41	0.37
2.25	45	0.41
2.50	50	0.46
2.75	54	0.49
3.00	57	0.52
3.25	59	0.54
3.50	61	0.56
3.75	64	0.58
4.00	66	0.60
4.25	68	0.62
4.50	71	0.65
4.75	73	0.66
5.00	75	0.68
5.25	78	0.71
5.50	82	0.75
5.75	86	0.78
6.00	91	0.83
6.25	93	0.85
6.50	95	0.86
6.75	98	0.89
7.00	102	0.93
7.25	104	0.95
7.50	106	0.96



Test Depth: GL

Mass of Split Rings: 0

PR Factor: 9.1 N/Div

Soil Description:
MADEGROUND: Brown clayey gravel

CBR at 2.50mm 3.44 %

CBR at 5.00mm 3.42 %

CBR Value: 3.4 %

Checked By: D.M.

REMARKS:

Carried out in accordance with BS1377: Part 9: 1990, Test 4.3

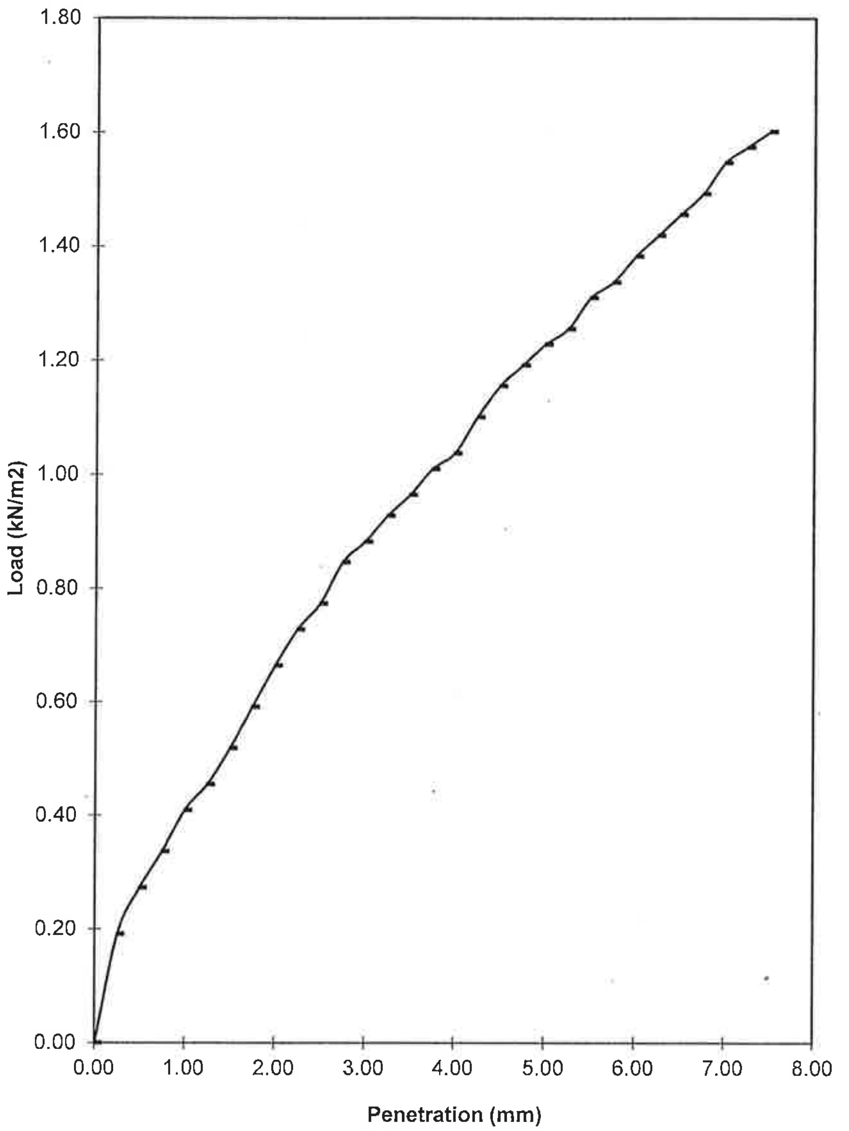
CONTRACT:
Atlantic Waste, Wentloog

DATE: 27.08.14
TEST REFERENCE: CBR 4

SOUTHERN GROUND TESTING

IN SITU CBR TEST

PENETRATION (mm)	PR READING (divs)	LOAD (KN)
0.00	0	0.00
0.25	21	0.19
0.50	30	0.27
0.75	37	0.34
1.00	45	0.41
1.25	50	0.46
1.50	57	0.52
1.75	65	0.59
2.00	73	0.66
2.25	80	0.73
2.50	85	0.77
2.75	93	0.85
3.00	97	0.88
3.25	102	0.93
3.50	106	0.96
3.75	111	1.01
4.00	114	1.04
4.25	121	1.10
4.50	127	1.16
4.75	131	1.19
5.00	135	1.23
5.25	138	1.26
5.50	144	1.31
5.75	147	1.34
6.00	152	1.38
6.25	156	1.42
6.50	160	1.46
6.75	164	1.49
7.00	170	1.55
7.25	173	1.57
7.50	176	1.60



Test Depth: GL

Mass of Split Rings: 0

PR Factor: 9.1 N/Div

Soil Description:
MADEGROUND: Brown clayey gravel

CBR at 2.50mm 5.84 %

CBR at 5.00mm 6.15 %

CBR Value: 6.2 %

Checked By: D.M.

REMARKS:

Carried out in accordance with BS1377: Part 9: 1990, Test 4.3

CONTRACT:
Atlantic Waste, Wentloog

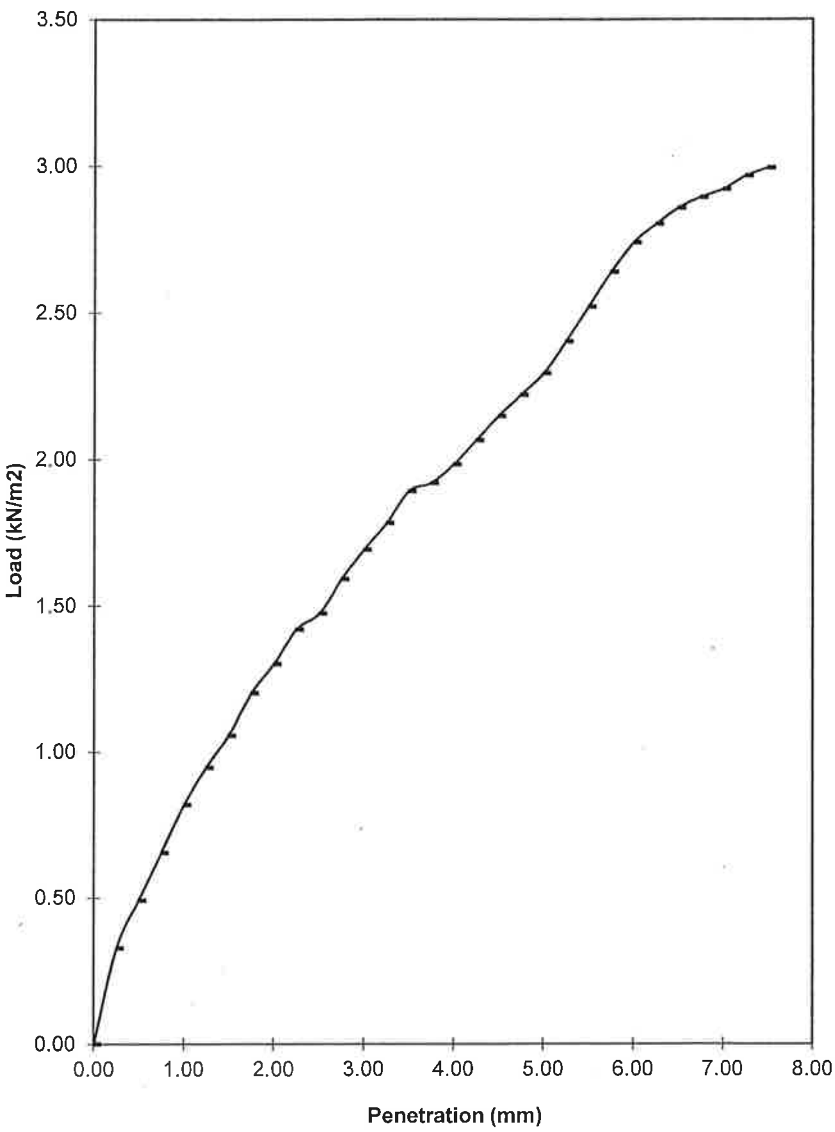
DATE: 27.08.14

TEST REFERENCE: CBR 5

SOUTHERN GROUND TESTING

IN SITU CBR TEST

PENETRATION (mm)	PR READING (divs)	LOAD (KN)
0.00	0	0.00
0.25	36	0.33
0.50	54	0.49
0.75	72	0.66
1.00	90	0.82
1.25	104	0.95
1.50	116	1.06
1.75	132	1.20
2.00	143	1.30
2.25	156	1.42
2.50	162	1.47
2.75	175	1.59
3.00	186	1.69
3.25	196	1.78
3.50	208	1.89
3.75	211	1.92
4.00	218	1.98
4.25	227	2.07
4.50	236	2.15
4.75	244	2.22
5.00	252	2.29
5.25	264	2.40
5.50	277	2.52
5.75	290	2.64
6.00	301	2.74
6.25	308	2.80
6.50	314	2.86
6.75	318	2.89
7.00	321	2.92
7.25	326	2.97
7.50	329	2.99



Test Depth: GL

Mass of Split Rings: 0

PR Factor: 9.1 N/Div

Soil Description:
MADEGROUND: Compact brown slightly clayey gravel

CBR at 2.50mm 11.13 %

CBR at 5.00mm 11.49 %

CBR Value: 11.5 %

Checked By: D.M.

REMARKS:

Carried out in accordance with BS1377: Part 9: 1990, Test 4.3

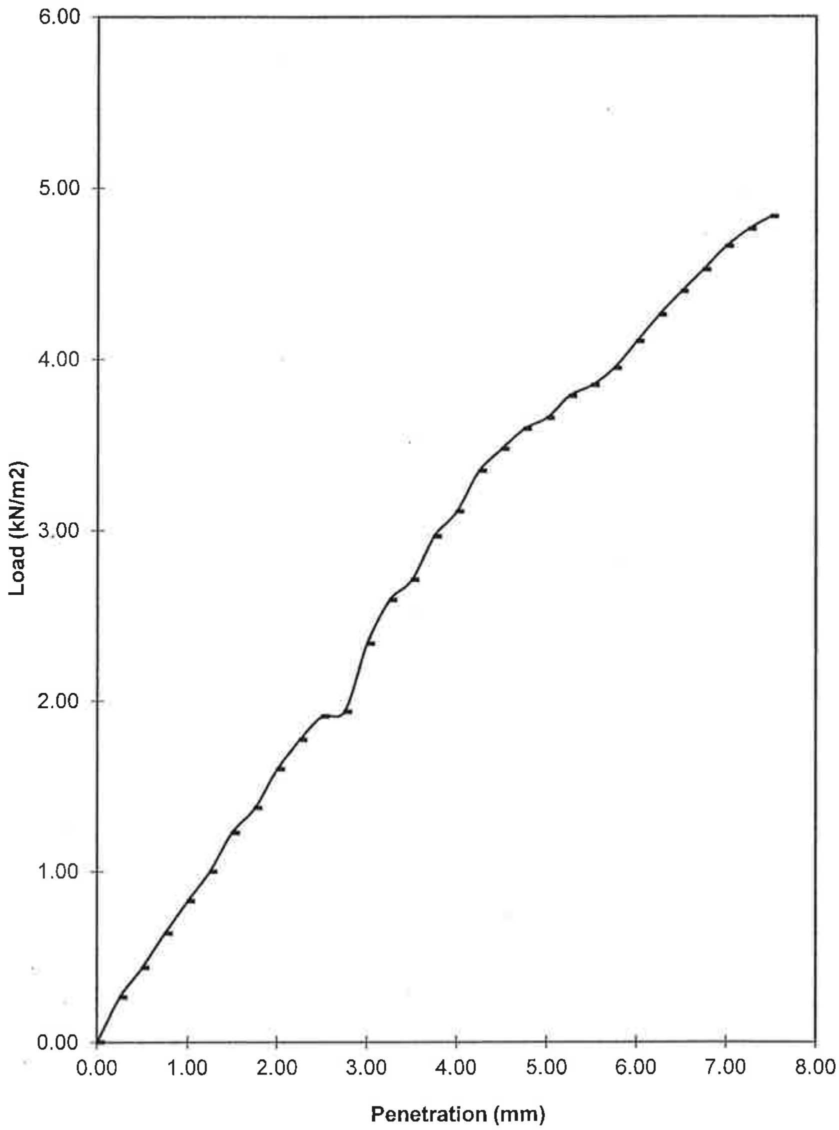
CONTRACT:
Atlantic Waste, Wentloog

DATE: 27.08.14
TEST REFERENCE: CBR 6

SOUTHERN GROUND TESTING

IN SITU CBR TEST

PENETRATION (mm)	PR READING (divs)	LOAD (KN)
0.00	0	0.00
0.25	29	0.26
0.50	48	0.44
0.75	70	0.64
1.00	91	0.83
1.25	110	1.00
1.50	135	1.23
1.75	151	1.37
2.00	176	1.60
2.25	195	1.77
2.50	210	1.91
2.75	213	1.94
3.00	257	2.34
3.25	285	2.59
3.50	298	2.71
3.75	326	2.97
4.00	342	3.11
4.25	368	3.35
4.50	382	3.48
4.75	395	3.59
5.00	402	3.66
5.25	416	3.79
5.50	423	3.85
5.75	434	3.95
6.00	451	4.10
6.25	468	4.26
6.50	483	4.40
6.75	497	4.52
7.00	512	4.66
7.25	523	4.76
7.50	531	4.83



Test Depth: GL

Mass of Split Rings: 0

PR Factor: 9.1 N/Div

Soil Description:
MADEGROUND: Compact brown slightly clayey gravel

CBR at 2.50mm 14.43 %

CBR at 5.00mm 18.33 %

CBR Value: 18.3 %

Checked By: D.M.

REMARKS:

Carried out in accordance with BS1377: Part 9: 1990, Test 4.3

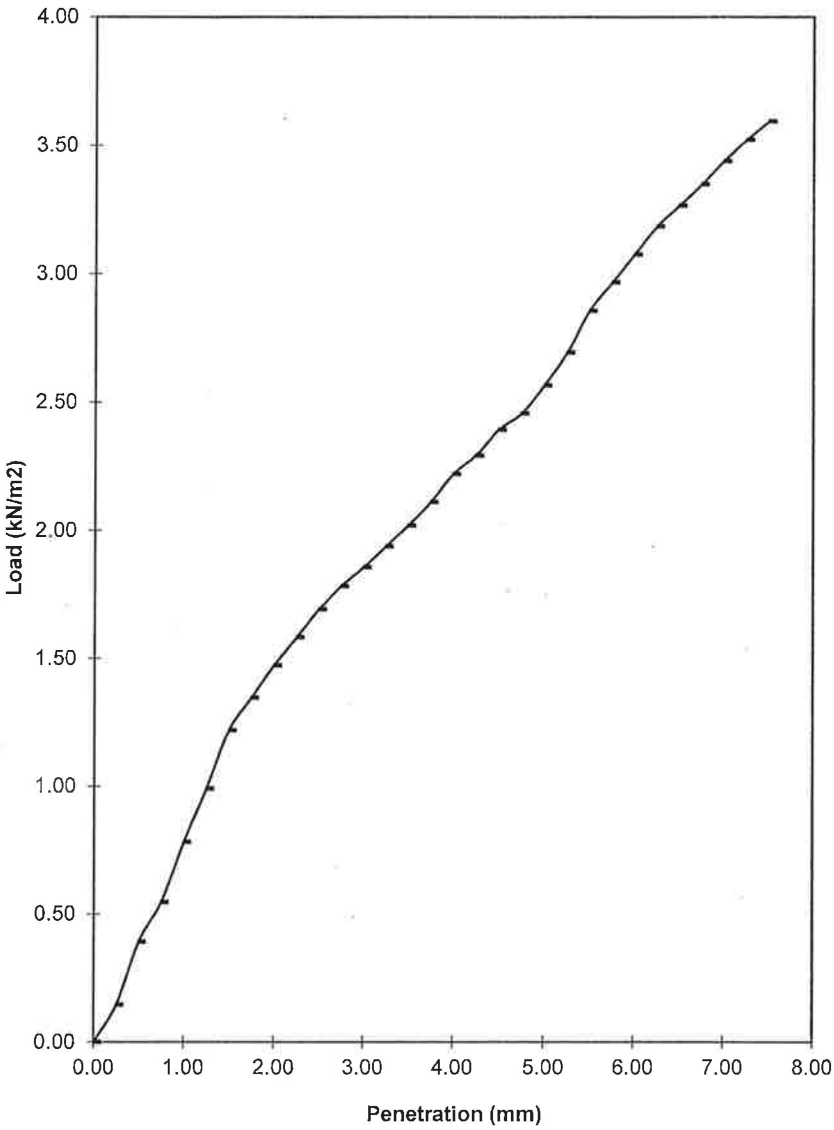
CONTRACT:
Atlantic Waste, Wentloog

DATE: 27.08.14
TEST REFERENCE: CBR 7

SOUTHERN GROUND TESTING

IN SITU CBR TEST

PENETRATION (mm)	PR READING (divs)	LOAD (KN)
0.00	0	0.00
0.25	16	0.15
0.50	43	0.39
0.75	60	0.55
1.00	86	0.78
1.25	109	0.99
1.50	134	1.22
1.75	148	1.35
2.00	162	1.47
2.25	174	1.58
2.50	186	1.69
2.75	196	1.78
3.00	204	1.86
3.25	213	1.94
3.50	222	2.02
3.75	232	2.11
4.00	244	2.22
4.25	252	2.29
4.50	263	2.39
4.75	270	2.46
5.00	282	2.57
5.25	296	2.69
5.50	314	2.86
5.75	326	2.97
6.00	338	3.08
6.25	350	3.19
6.50	359	3.27
6.75	368	3.35
7.00	378	3.44
7.25	387	3.52
7.50	395	3.59



Test Depth: GL

Mass of Split Rings: 0

PR Factor: 9.1 N/Div

Soil Description:
MADEGROUND: Compact brown slightly clayey gravel

CBR at 2.50mm 12.78 %

CBR at 5.00mm 12.86 %

CBR Value: 12.9 %

Checked By: D.M.

REMARKS:

Carried out in accordance with BS1377: Part 9: 1990, Test 4.3

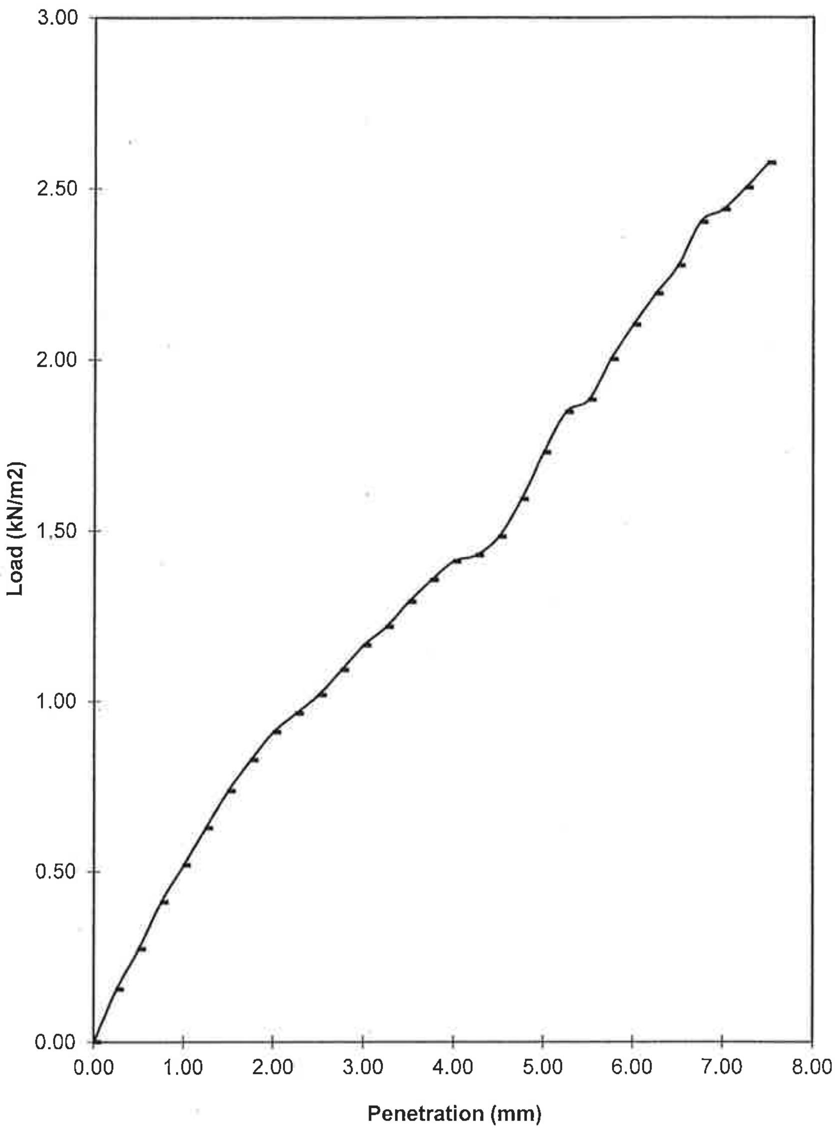
CONTRACT:
Atlantic Waste, Wentloog

DATE: 27.08.14
TEST REFERENCE: CBR 8

SOUTHERN GROUND TESTING

IN SITU CBR TEST

PENETRATION (mm)	PR READING (divs)	LOAD (KN)
0.00	0	0.00
0.25	17	0.15
0.50	30	0.27
0.75	45	0.41
1.00	57	0.52
1.25	69	0.63
1.50	81	0.74
1.75	91	0.83
2.00	100	0.91
2.25	106	0.96
2.50	112	1.02
2.75	120	1.09
3.00	128	1.16
3.25	134	1.22
3.50	142	1.29
3.75	149	1.36
4.00	155	1.41
4.25	157	1.43
4.50	163	1.48
4.75	175	1.59
5.00	190	1.73
5.25	203	1.85
5.50	207	1.88
5.75	220	2.00
6.00	231	2.10
6.25	241	2.19
6.50	250	2.28
6.75	264	2.40
7.00	268	2.44
7.25	275	2.50
7.50	283	2.58



Test Depth: GL	Soil Description: MADEGROUND: Compact brown slightly clayey gravel	CBR at 2.50mm 7.70 %
Mass of Split Rings: 0		CBR at 5.00mm 8.66 %
PR Factor: 9.1 N/Div		**CBR Value: 8.7 %**
		Checked By: D.M.

REMARKS:

Carried out in accordance with BS1377: Part 9: 1990, Test 4.3

CONTRACT: Atlantic Waste, Wentloog

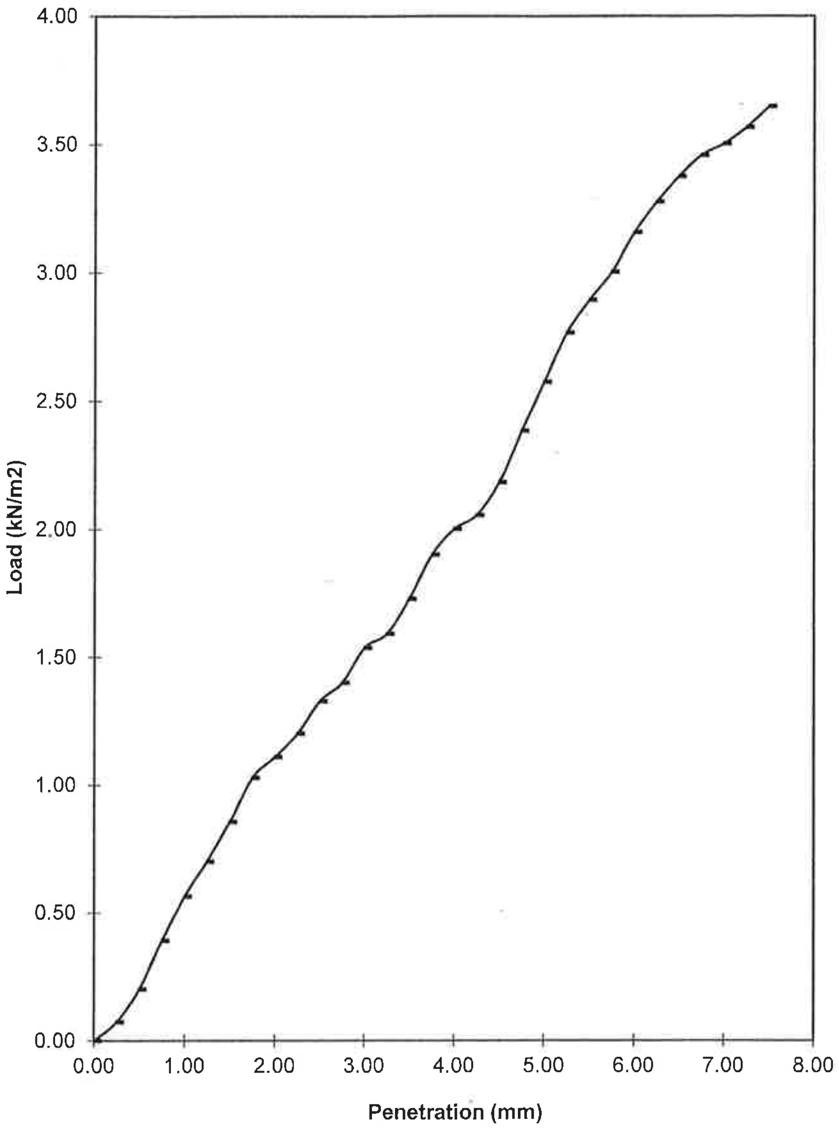
DATE: 27.08.14

TEST REFERENCE: CBR 9

SOUTHERN GROUND TESTING

IN SITU CBR TEST

PENETRATION (mm)	PR READING (divs)	LOAD (KN)
0.00	0	0.00
0.25	8	0.07
0.50	22	0.20
0.75	43	0.39
1.00	62	0.56
1.25	77	0.70
1.50	94	0.86
1.75	113	1.03
2.00	122	1.11
2.25	132	1.20
2.50	146	1.33
2.75	154	1.40
3.00	169	1.54
3.25	175	1.59
3.50	190	1.73
3.75	209	1.90
4.00	220	2.00
4.25	226	2.06
4.50	240	2.18
4.75	262	2.38
5.00	283	2.58
5.25	304	2.77
5.50	318	2.89
5.75	330	3.00
6.00	347	3.16
6.25	360	3.28
6.50	371	3.38
6.75	380	3.46
7.00	385	3.50
7.25	392	3.57
7.50	401	3.65



Test Depth: GL	Soil Description: MADEGROUND: Compact brown slightly clayey gravel	CBR at 2.50mm 10.03 %
Mass of Split Rings: 0		CBR at 5.00mm 12.90 %
PR Factor: 9.1 N/Div		**CBR Value: 12.9 %**
		Checked By: D.M.

REMARKS:

Carried out in accordance with BS1377: Part 9: 1990, Test 4.3

CONTRACT: Atlantic Waste, Wentloog

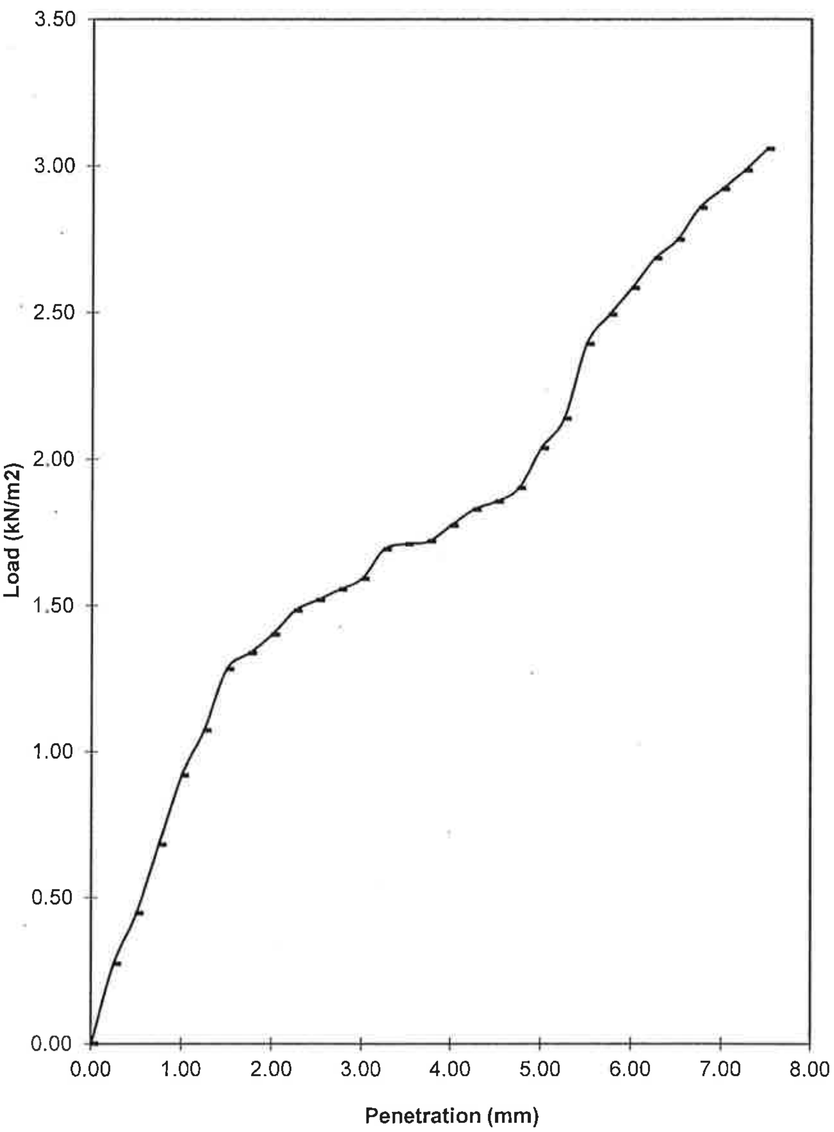
DATE: 27.08.14

TEST REFERENCE: CBR 10

SOUTHERN GROUND TESTING

IN SITU CBR TEST

PENETRATION (mm)	PR READING (divs)	LOAD (KN)
0.00	0	0.00
0.25	30	0.27
0.50	49	0.45
0.75	75	0.68
1.00	101	0.92
1.25	118	1.07
1.50	141	1.28
1.75	147	1.34
2.00	154	1.40
2.25	163	1.48
2.50	167	1.52
2.75	171	1.56
3.00	175	1.59
3.25	186	1.69
3.50	188	1.71
3.75	189	1.72
4.00	195	1.77
4.25	201	1.83
4.50	204	1.86
4.75	209	1.90
5.00	224	2.04
5.25	235	2.14
5.50	263	2.39
5.75	274	2.49
6.00	284	2.58
6.25	295	2.68
6.50	302	2.75
6.75	314	2.86
7.00	321	2.92
7.25	328	2.98
7.50	336	3.06



Test Depth: GL	Soil Description: MADEGROUND: Compact brown slightly clayey gravel	CBR at 2.50mm 11.48 %
Mass of Split Rings: 0		CBR at 5.00mm 10.21 %
PR Factor: 9.1 N/Div		**CBR Value: 11.5 %**
		Checked By: D.M.

REMARKS:

Carried out in accordance with BS1377: Part 9: 1990, Test 4.3

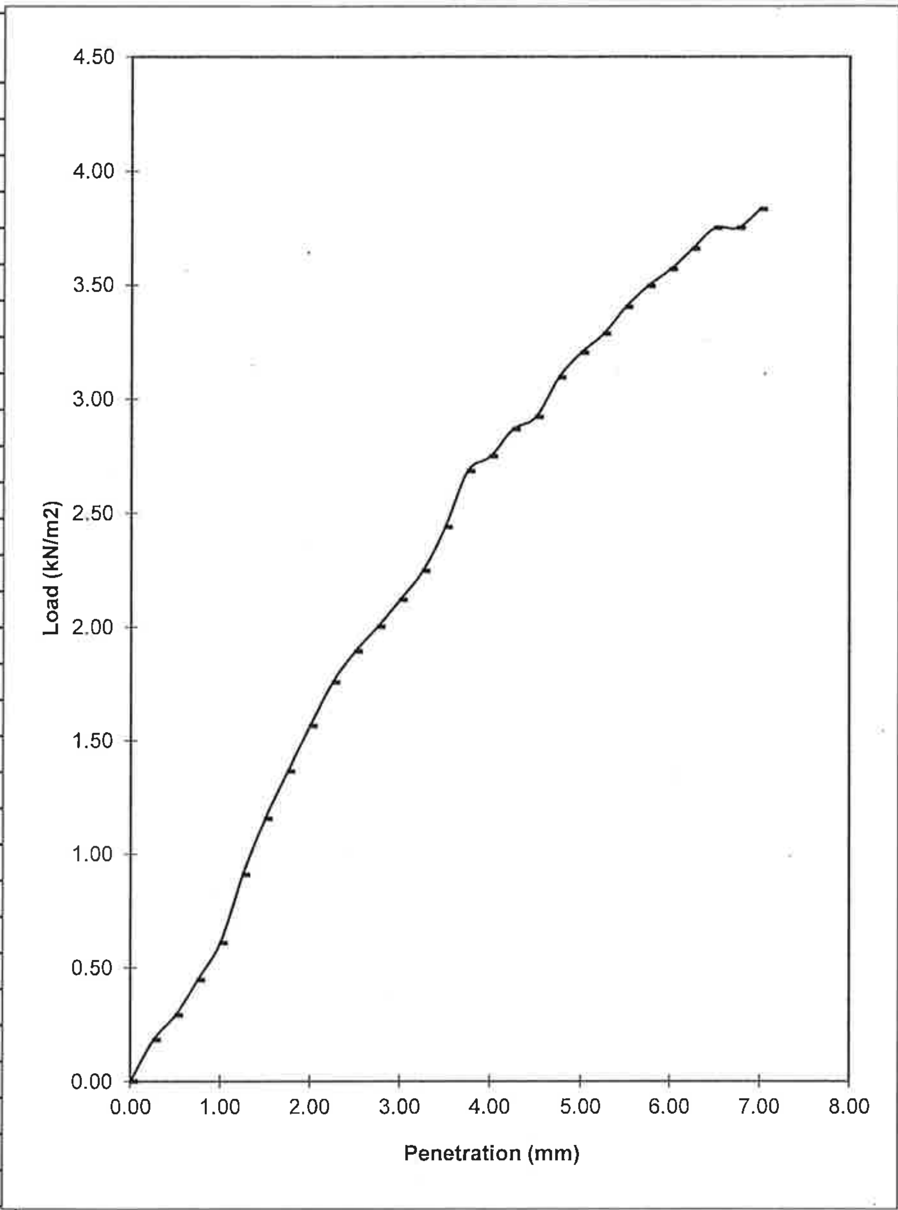
CONTRACT:
Atlantic Waste, Wentloog

DATE: 27.08.14
TEST REFERENCE: CBR 11

SOUTHERN GROUND TESTING

IN SITU CBR TEST

PENETRATION (mm)	PR READING (divs)	LOAD (KN)
0.00	0	0.00
0.25	20	0.18
0.50	32	0.29
0.75	49	0.45
1.00	67	0.61
1.25	100	0.91
1.50	127	1.16
1.75	150	1.37
2.00	172	1.57
2.25	193	1.76
2.50	208	1.89
2.75	220	2.00
3.00	233	2.12
3.25	247	2.25
3.50	268	2.44
3.75	295	2.68
4.00	302	2.75
4.25	315	2.87
4.50	321	2.92
4.75	340	3.09
5.00	352	3.20
5.25	361	3.29
5.50	374	3.40
5.75	384	3.49
6.00	392	3.57
6.25	402	3.66
6.50	412	3.75
6.75	412	3.75
7.00	421	3.83



Test Depth: GL	Soil Description: MADEGROUND: Compact brown slightly clayey gravel	CBR at 2.50mm 14.30 %
Mass of Split Rings: 0		CBR at 5.00mm 16.05 %
PR Factor: 9.1 N/Div		**CBR Value: 16.1 %**
		Checked By: D.M.
REMARKS:		Carried out in accordance with BS1377: Part 9: 1990, Test 4.3
CONTRACT: Atlantic Waste, Wentloog		DATE: 27.08.14 TEST REFERENCE: CBR 12